

REMARKS

With respect to “Information Disclosure Statement” on page 2 of the Office Action, in accordance with the Examiner’s request, copies of the two Japanese documents not furnished directly by WIPO are being submitted herewith, along with a computer translation of at least a portion of each. A written indication of consideration of the references is respectfully requested.

The claims have been amended to avoid the objections of the Examiner.

In rejecting claims 1-8 under 35 USC 112 on the ground that “means for changing the degree of opening of plural openings at the rear ends of the cutting fluid feed passages” does not have proper support in the original disclosure, the Examiner interprets this means-plus-function phrase as requiring a single structure that changes the degree of opening of plural openings. However, “means for changing the degree of opening of plural openings” is not limited to a single structure that performs the function, but is also satisfied by a plurality of structures that together perform the function, as is the case with the illustrated embodiment in the present application. A plurality of separate individual structures, each of which changes the degree of opening of an opening, together comprise “means for changing the degree of opening of plural openings”. With respect to the inventors having possession of the claimed invention at the time the application was filed, it is pointed out that “means for changing degrees of openings at the rear ends of cutting fluid feed passages” (plural) was recited in the original claims, which are part of the original disclosure.

With respect to the three prior art rejections in the Office Action, based on various combinations of prior art, the applicants refer to the Remarks in the Amendment filed on June 2, 2006, pertinent portions of which are reproduced below. In the “Response to Arguments” on pages 5 and 6 of the Office Action, the Examiner seems to take the position that a disclosure of

controlling the degree of opening of the opening of any passage would have rendered obvious placing means for changing the degree of opening of openings at the rear ends of the cutting fluid passages provided at rotating centers of spindles having tools at the tips thereof. The Examiner refers to a fluid feed passage “as broadly interpreted”. However, the applicants point out that the claims do not recite a fluid feed passage “as broadly interpreted”, but rather, claim 1, for example, recites “a plurality of spindles having tools at tips thereof” and “cutting fluid feed passages provided at rotating centers of the spindles”, as is shown in Fig. 3. The action and effect of this feature is disclosed at page 10, lines 12-25 of the original specification. In addition, claim 1, for example, recites “means for changing the degree of opening of plural openings at the rear ends of the cutting fluid feed passages”. The references do not suggest “means for changing the degree of opening of plural openings” at the rear ends of the cutting fluid feed passages, even when the references are considered in combination. Furthermore, as was discussed in the Remarks in the Amendment filed on June 2, 2006, Inoue ‘212, for example, actually teaches away from adding an opening degree changing means for changing degrees of openings at the rear ends of the cutting fluid feed passages. It teaches away by disclosing placing opening degree changing means in a different location.

Remarks in the Amendment filed on June 2, 2006

Reconsideration of the rejection of claims 1-5 under 35 USC 103 as being unpatentable over WO/37439 in view of Inoue ‘212 is respectfully requested. The Examiner acknowledges that WO99/37439 lacks an opening degree changing means for changing degrees of openings at the rear ends of the cutting fluid feed passages, but contends that Inoue ‘212 makes obvious the addition of an opening degree changing

means to the apparatus of WO99/37439. In fact, Inoue '212 teaches away from adding an opening degree changing means for changing degrees of openings at the rear ends of the cutting fluid feed passages. The Inoue' 212 reference relates to a cutting-oil coater for applying cutting-oil to a workpiece or a tool during cutting. Column 4, lines 16-22 disclose: "The oil spray passing through the spray conveying passage 4 finally is discharged into the atmosphere from a tip 4a having a narrower diameter. The flow velocity of the oil spray is increased at the tip 4a, and the oil spray is changed to the state of an oil droplet so that it can be attached to a work piece. This discharging flow can be used as a lubricant for cutting." Thus, the spray conveying passage 4 is the part of the Inoue '212 apparatus that is the closest to the point of lubrication. In this respect, the spray conveying passage 4 is the part of the Inoue '212 apparatus that is more analogous to the cutting fluid feed passages 'b' of WO/37439 than is any other part of the Inoue '212 apparatus. However, Inoue '212 does not disclose or suggest placing an opening degree changing means at the rear end of the spray conveying passage 4. Instead, Inoue '212 discloses placing a needle 43 in the oil inlet port 42 of a tank to vary the flow of oil flowing from an oil return passage. The oil inlet port 42 is at the bottom of the container 2, whereas the spray conveying passage extends out of the top of the container. Thus, Inoue '212 does not disclose or suggest adding an opening degree changing means for changing degrees of openings at the rear ends of the cutting fluid feed passages of WO/37439. One of ordinary skill who viewed these two references at the time the present invention was made would not have any incentive for placing any structure like the needle 43 of Inoue '212 in either the spray conveying passage 4 of Inoue '212 or the cutting fluid feed passages 'b' of WO/37439.

Reconsideration of the rejection of claims 1-5 under 35 USC 103 as being unpatentable over WO/37439 in view of JP 05162046 is respectfully requested. The Examiner acknowledges that WO99/37439 lacks an opening degree changing means for changing degrees of openings at the rear ends of the cutting fluid feed passages, but contends that JP 05162046 makes obvious the addition of an opening degree changing means to the apparatus of WO99/37439. In JP 05162046, a needle valve is provided at an exit where lubricant inside a tank is pushed out by a piston 4. The mere disclosure that a needle valve is used in connection with the flow of a lubricant does not suggest or render obvious modifying WO99/37439 to provide opening degree changing means for changing the degree of opening of openings that are at the rear ends of the cutting fluid feed passages, as is required by claims 1 and 2. In fact, JP 05162046 teaches away from this, since it discloses delivering the lubricant peripherally through a tube to the point where the work is being performed rather than through cutting fluid feed passages that are at rotating centers of spindles, as is recited in claims 1 and 2.

Reconsideration of the rejection of claims 1-5 under 35 USC 103 as being unpatentable over WO99/37439 in view of Eckardt is respectfully requested. The Examiner acknowledges that WO99/37439 lacks an opening degree changing means for changing degrees of openings at the rear ends of the cutting fluid feed passages, but contends that Eckardt makes obvious the addition of an opening degree changing means to the apparatus of WO99/37439. Claims 1 and 2 recite a plurality of spindles, cutting fluid feed passages at rotating centers of the spindles, a common closed chamber at rear parts of the spindles, atomized lubricant fed to the common closed chamber adapted to jet from the tips of the corresponding tools through the cutting fluid feed passages, and

opening degree changing means for changing the degree of opening of openings at the rear ends of the cutting fluid feed passages. Eckardt has none of these features. Although Eckardt discloses needle valves or valve plugs 34 in a valve block 33 for adjusting the flow rate of fluids through the block, it would not have suggested to one of ordinary skill to use such an arrangement to change the degree of opening of a plurality of openings at the rear ends of the cutting fluid feed passages of WO99/37439, which are at rotating centers of spindles. Eckardt shows a coolant and lubricant nozzle 39 that is separate from an apparently solid drill bit W. Furthermore, Eckardt stresses the importance of manually regulating the flow of each of coolant, lubricant and air (column 1, line 68 – column 2, line 2), and for this reason, he provides three needle valves 34, one for each medium. Thus, also for this additional reason, Eckardt would not have suggested to one of ordinary skill to place one of the needle valves 34 of Eckardt, or three of them (if it were possible), to change the degree of opening of a plurality of openings at the rear ends of the cutting fluid feed passages of WO99/37439.

With respect to each of the rejections, it is pointed out that claims 1 and 2 recite a plurality of spindles, cutting fluid feed passages at rotating centers of the spindles; and opening degree changing means for changing the degree of opening of openings at the rear ends of the cutting fluid feed passages. Thus, claims 1 and 2 recite means for changing the degree of opening of plural openings at the rear ends of the cutting fluid feed passages. This is not suggested by the references, whether taken individually or in combination. In each of the modifying references the variation in flow is performed at a source of supply rather than at the rear ends of the cutting fluid feed passages, and does not suggest adjusting the amount of flow of plural openings at the rear ends of the cutting

fluid feed passages. By the present amendment, claims 1 and 2 have been amended to recite that the opening degree changing means is opening degree changing means for changing the degree of opening of plural openings at the rear ends of the cutting fluid feed passages.

Also with respect to each of the rejections, it is pointed out that claims 1 and 2 recite that atomized lubricant fed to the common closed chamber is adapted to jet from the tips of the corresponding tools through the cutting fluid feed passages. Thus, the opening degree changing means acts on atomized lubricant. In order to recite this feature even more clearly, claims 1 and 2 have been amended to recite the changing means as “opening degree changing means for changing the degree of opening of openings at the rear ends of the cutting fluid feed passages to change the flow rate of atomized lubricant into the cutting fluid feed passages.” In each of the modifying references applied by the Examiner, fluids other than atomized lubricant are controlled. In Inoue ‘212 and JP 05162046, liquid oil is controlled; and in Eckardt, liquid coolant, liquid lubricant and air are controlled individually.

In view of the foregoing, the applicants submit that all the claims are allowable and that the application is in condition for allowance. An early notice to that effect is respectfully requested.


The Commissioner is hereby authorized to charge any deficiency in fees or to credit any

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Respectfully submitted,

Date: 10-31-06


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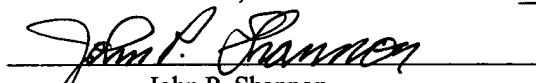
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PATENT ABSTRACTS OF JAPAN

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(71)Applicant : MITSUBISHI HEAVY IND LTD

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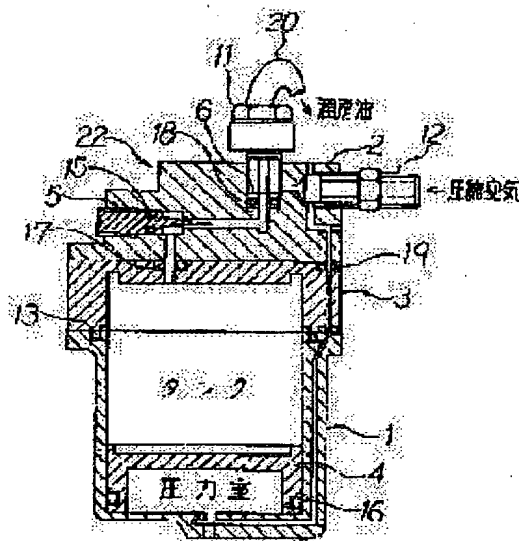
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(54) MIST APPLICATOR DEVICE

(57)Abstract:

PURPOSE: To apply automatically satisfactory sprayed lubricating oil to a cutting edge of a drill by providing a cylinder partitioned into a lubricating oil tank and pressure chamber by a piston and a nose joint communicating through a needle valve and guide piston to the lubricating oil tank.

CONSTITUTION: Compressed air flows through an air ventilating path provided in a cylinder 1 to a pressure chamber in the lower part of the cylinder 1. Pressure is applied to a piston 4 by the compressed air pressure to send lubricating oil to a needle valve 5. The lubricating oil adjusted by the needle valve 5 is mixed with the compressed air by a guide piston 6 and sent through a swing joint 11 and tube 20 to a nose joint by which the lubricating oil is sprayed to be applied to a cutting edge of a drill.



LEGAL STATUS

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CLAIMS

[Claim(s)]

[Claim 1] the cylinder divided into the lubricating oil tank and the pressure room with the piston which can slide, and the nose which is open for free passage to the above-mentioned lubricating oil tank through a needle valve and a step piston -- the Myst applicator equipment characterized by providing a joint and a means to supply the compressed air to the above-mentioned pressure room and the above-mentioned step piston.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is applicable to all the Ayr power tools that need a lubricating oil for a power tool about the Myst applicator equipment using the compressed air supplied or exhausted.

[0002]

[Description of the Prior Art] When doing a close-tolerance hole dawn activity with the Ayr power tool generally, it is necessary to prevent generating and are recording of heat by friction with the edge of a blade of a tool, and a workpiece. Then, conventionally, the activity which carries out the spray of the lubricating oil, or applies a direct lubricating oil as shown in a drill point at drawing 5 was done once using the help.

[0003]

[Problem(s) to be Solved by the Invention] Since the lubricating oil was applied once to the edge of a blade of a drill by handicraft, the continuous hole dawn activity was not completed but it was conventionally inefficient. This invention aims at enabling it to apply the lubricating oil of optimum dose to the drill edge of a blade automatically with the small lightweight equipment attached in the Ayr power tool.

[0004]

[Means for Solving the Problem] the cylinder divided into the lubricating oil tank and the pressure room with the piston which can slide in order that this invention might solve said conventional technical problem, and the nose which is open for free passage to the above-mentioned lubricating oil tank through a needle valve and a step piston -- the Myst applicator equipment characterized by providing a joint and a means to supply the compressed air to the above-mentioned pressure room and the above-mentioned step piston is proposed.

[0005]

[Function] If the compressed air is supplied to a pressure room, the lubricating oil in a tank will be extruded by the piston and will result in a step piston through a needle valve. here -- a lubricating oil and the compressed air -- mixing -- a nose -- it becomes a letter of spraying with a joint, and is applied to the tool edge of a blade. Here, in order to apply Myst of the minimum optimum dose to the edge of a blade according to processing conditions, volume is adjusted by the needle valve.

[0006]

[Example] Similarly the top view in which drawing 1 shows one example of the Myst applicator equipment of this invention, and drawing 2 are side elevations. Drawing 3 is drawing 1 . III-III It is a vertical section side-face enlarged drawing. Drawing 4 is the perspective view showing the condition of having equipped the Ayr power tool (tooth-space MACHIKKU drill motor) with the equipment of this example.

[0007] Introduction drawing 4 explains briefly the Ayr power tool (tooth-space MACHIKKU drill motor) (21). First, a hole dawn member is clamped by the collet (26) and the template foot (28) by lengthening a trigger (25). Moreover, the drill (23) which the main cylinder (27) retreated to coincidence and was attached in it at the spindle (29) performs hole dawn pan picking.

[0008] Next, a concrete procedure is described, also referring to drawing 1 thru/or drawing 3 .

- 1) Attach Myst applicator equipment (22) in the Ayr power tool (21), and fix to it.
- 2) Attach a nipple (12) in the exhaust port (depending on a tool, it is a feed hopper) of a power tool.
- 3) a nose -- turn a joint (8) to the edge of a blade of a drill (23), and fix.
- 4) Open a plug (7) and pour in a lubricating oil into a tank. The above is a dead work.

[0009] Next, the compressed air consumed within the power tool is emitted out of a power tool by lengthening the trigger (25) of the Ayr power tool (21). The emitted compressed air is sent to Myst applicator equipment (22) through a nipple (12). The compressed air passes along an end plate (2), a spacer plate (3), and the airstream path established in the interior of a cylinder (1), and flows to the pressure room of the cylinder (1) lower part. A pressure joins a piston (4) with the compressed-air pressure, and a lubricating oil is sent to a needle valve (5).

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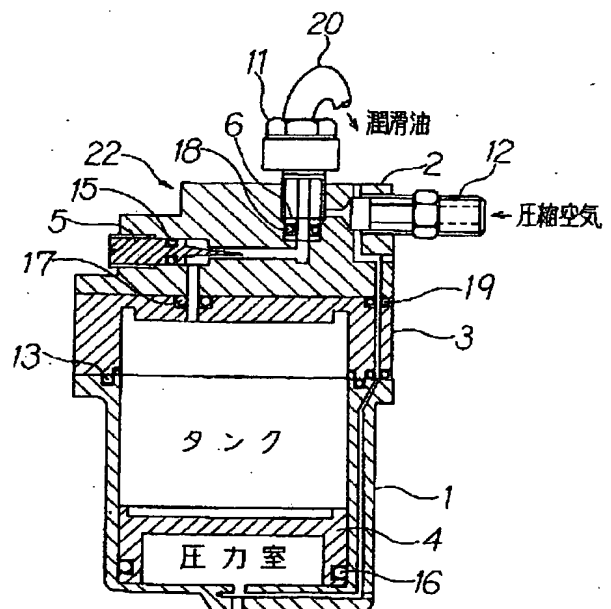
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(54)【発明の名称】 ミストアプリケーター装置

(57)【要約】

【目的】 エアー動力工具で穴明け作業を行なう際、ドリルの刃先に潤滑油が自動的に塗布されるようにすること。

【構成】 工具の動力として供給される圧縮空気を利用し、その圧力でピストン(4)を押してタンク内の潤滑油を押出すとともに、圧縮空気の一部を混合して、ドリル刃先に噴霧状に吹付け塗布する。トリガーにより工具を回転させれば、潤滑油も自動的に噴霧される。



【特許請求の範囲】

【請求項1】 滑動できるピストンにより潤滑油タンクおよび圧力室に仕切られたシリンダーと、ニードル弁およびガイドピストンを介して上記潤滑油タンクに連通するノーズ継手と、上記圧力室および上記ガイドピストンに圧縮空気を供給する手段とを具備したことを特徴とするミストアプリケーター装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、動力工具に供給もしくは排気される圧縮空気を利用したミストアプリケーター装置に関するもので、潤滑油を必要とするすべてのエアード動力工具に適用できる。

【0002】

【従来の技術】一般にエアード動力工具で精密公差穴明け作業を行なうときは、工具の刃先と被加工物との摩擦による熱の発生と蓄積を防ぐ必要がある。そこで従来は、ドリル先端部に、図5に示されるように潤滑油をスプレーしたり、または直接潤滑油を塗布したりする作業を、1回1回人手を使って行なっていた。

【0003】

【発明が解決しようとする課題】従来はドリルの刃先に潤滑油を1回1回手作業で塗布していたので、連続した穴明け作業ができず、能率が悪かった。本発明は、エアード動力工具に取付けられた小型軽量の装置により、自動的にドリル刃先に適量の潤滑油を塗布できるようにすることを目的とする。

【0004】

【課題を解決するための手段】本発明は、前記従来の課題を解決するために、滑動できるピストンにより潤滑油タンクおよび圧力室に仕切られたシリンダーと、ニードル弁およびガイドピストンを介して上記潤滑油タンクに連通するノーズ継手と、上記圧力室および上記ガイドピストンに圧縮空気を供給する手段とを具備したことを特徴とするミストアプリケーター装置を提案するものである。

【0005】

【作用】圧力室に圧縮空気を供給すると、タンク内の潤滑油がピストンにより押出され、ニードル弁を経てガイドピストンに至る。ここで潤滑油と圧縮空気が混合し、ノーズ継手により噴霧状になって、工具刃先に塗布される。ここで、加工条件に応じて、最少適量のミストを刃先に塗布するため、ニードル弁により液量を調節する。

【0006】

【実施例】図1は本発明のミストアプリケーター装置の一実施例を示す平面図、図2は同じく側面図である。図3は図1のIII-III縦断側面拡大図である。図4は本実施例の装置をエアード動力工具（スペースマチックドリルモーター）に装着した状態を示す斜視図である。

【0007】初めに図4により、エアード動力工具（ス

ペースマチックドリルモーター）（21）について簡単に説明する。まず、トリガー（25）を引くことにより、コレット（26）とテンプレートフット（28）で穴明け部材をクランプする。また同時に、メインシリンダー（27）が後退し、スピンドル（29）に取りつけられたドリル（23）により、穴明け皿取りを行なうのである。

【0008】次に図1ないし図3をも参照しつつ、具体的な手順を述べる。

1) エアード動力工具（21）にミストアプリケーター装置（22）を取付け固定する。

2) ニップル（12）を動力工具の排気口（工具によっては供給口）へ取付ける。

3) ノーズ継手（8）をドリル（23）の刃先に向けて固定する。

4) プラグ（7）を開き、潤滑油をタンク内に注入する。以上が準備作業である。

【0009】次に、エアード動力工具（21）のトリガー（25）を引くことにより、動力工具内で消費された圧縮空気が、動力工具外へ放出される。その放出された圧縮空気は、ニップル（12）を通してミストアプリケーター装置（22）に送られる。圧縮空気はエンドプレート（2）、スペーサープレート（3）、シリンダー

（1）の内部に設けられた空気流通路を通り、シリンダー（1）下部の圧力室へ流れる。その圧縮空気圧力によりピストン（4）に圧力が加わり、潤滑油はニードル弁（5）へ送られる。ニードル弁（5）を閉じれば少量に、開けば多くの潤滑油を流すことができ、最少適量の調整ができる。

【0010】調整された潤滑油は、ガイドピストン（6）で圧縮空気と混合され、スイング継手（11）、チューブ（20）を通り、ノーズ継手（8）へ送られる。そしてノーズ継手（8）により潤滑油を噴霧状にしてドリル（23）の刃先へ塗布することができる。

【0011】上記のように本実施例においては、動力工具（21）の動力として供給され排気される圧縮空気を利用し、その圧縮空気と混合された潤滑油をドリル刃先に塗布することにより、工具刃先と被加工物の間を浸潤して摩擦を押さえ、熱の発生と蓄積を防止することができる。

【0012】本実施例においてはまた、エアード動力工具（21）のトリガー（25）を引いている間は、ミストアプリケーター（22）がどんな方向であろうとも、圧縮空気が供給されて、圧力が加わっているから、潤滑油は常に流れていることになる。すなわち本実施例によれば、動力工具をどんな姿勢で作業しようとも、ドリル刃先に潤滑油が塗布される。

【0013】上述した実施例のミストアプリケーター装置を動力工具に装着して、実際に難削材加工および精密公差穴加工作業を行なったところ、ドリル先刃に良好な

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噴霧状の潤滑油が塗布され、連続した穴明け作業が可能となつて、穴明け工数を大幅に削減することができた。また同時に工具寿命も延長された。

【0014】

【発明の効果】難削材加工や精密公差穴加工作業において、従来は1回1回手作業でドリル刃先に潤滑油を塗布する必要があつたが、本発明によれば、ドリル先刃に良好な噴霧状の潤滑油が自動的に塗布されるので、連続した穴明け作業が可能となつて、穴明け工数を大幅に削減することができる。また同時に工具寿命も延長される。

【図面の簡単な説明】

【図1】図1は本発明のミストアプリケーター装置の一実施例を示す平面図である。

【図2】図2は図1の側面図である。

【図3】図3は図1の III-III 縦断側面拡大図である。

【図4】図4は上記実施例の装置をエアー動力工具（スペースマチックドリルモーター）に取付けた状態を示す斜視図である。

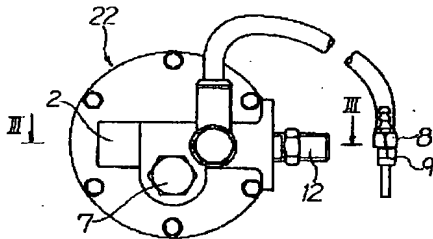
【図5】図5は従来の潤滑油塗布作業を示す斜視図である。

【符号の説明】

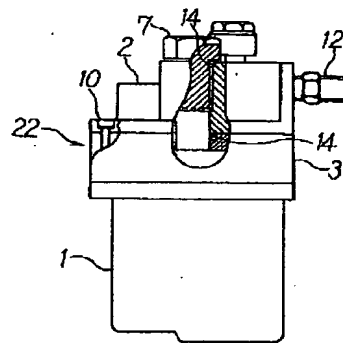
(1) シリンダー

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【図1】

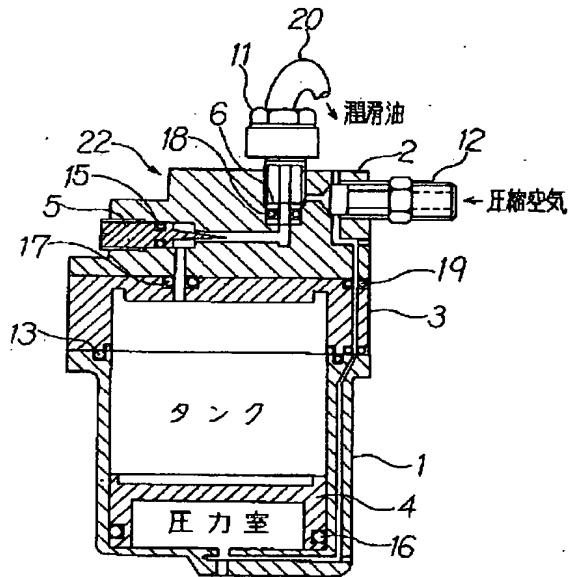


【図2】

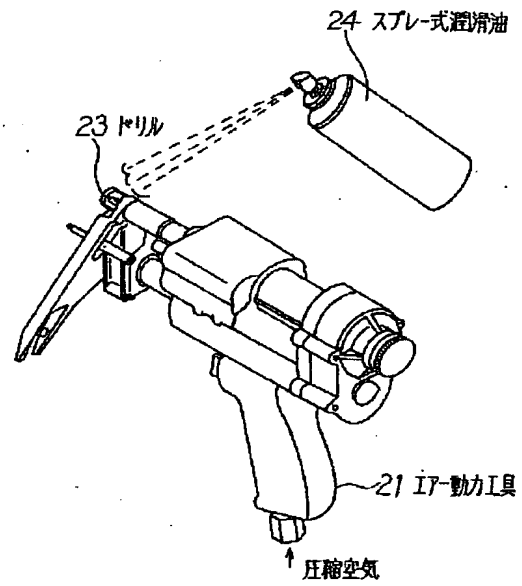


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| <p>(3)</p> <p>ック)</p> <p>(4)</p> <p>(5)</p> <p>(6)</p> <p>(7)</p> <p>(8)</p> <p>(9)</p> <p>(10)</p> <p>(11)</p> <p>(12)</p> <p>(13) ~ (19)</p> <p>(20)</p> <p>(21)</p> <p>(22)</p> <p>(23)</p> <p>(24)</p> <p>(25)</p> <p>(26)</p> <p>(27)</p> <p>(28)</p> <p>(29)</p> | <p>* (2)</p> <p>(3)</p> <p>ック)</p> <p>(4)</p> <p>(5)</p> <p>(6)</p> <p>(7)</p> <p>(8)</p> <p>(9)</p> <p>(10)</p> <p>(11)</p> <p>(12)</p> <p>(13) ~ (19)</p> <p>(20)</p> <p>(21)</p> <p>(22)</p> <p>(23)</p> <p>(24)</p> <p>(25)</p> <p>(26)</p> <p>(27)</p> <p>(28)</p> <p>(29)</p> | <p>エンドプレート</p> <p>スペーサープレート (透明プラスチック)</p> <p>ピストン</p> <p>ニードル弁</p> <p>ガイドピストン</p> <p>プラグ</p> <p>ノーズ継手</p> <p>Cスプリング</p> <p>キャップスクリュー</p> <p>スイング継手</p> <p>ニップル</p> <p>Oリング</p> <p>チューブ</p> <p>エアー動力工具</p> <p>ミストアプリケーター装置</p> <p>ドリル</p> <p>スプレー式潤滑剤</p> <p>トリガー</p> <p>コレット</p> <p>メインシリンダー</p> <p>テンプレートフット</p> <p>スピンドル</p> |
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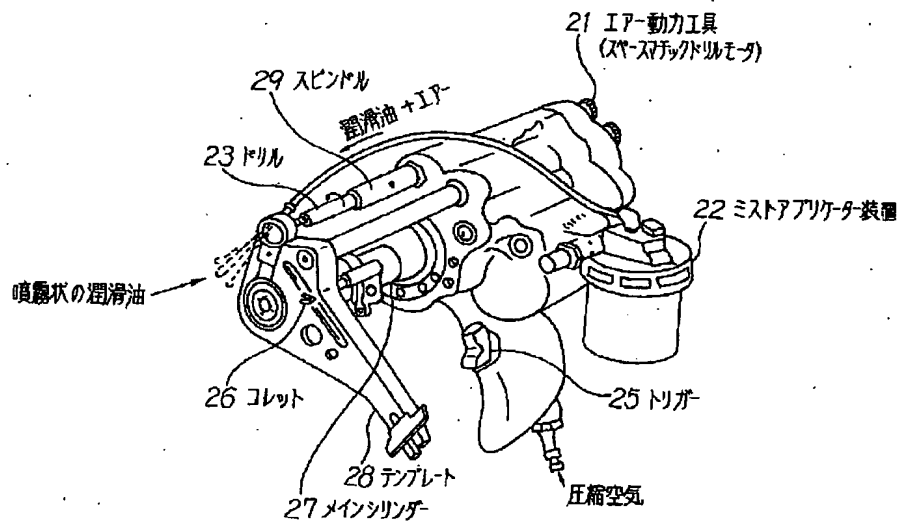
【図3】



【図5】



【図4】



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CLAIMS

[Utility model registration claim]

[Claim 1] In the multiaxial spindle head by which two or more arrangement of the spindle shaft equipped with the cutting-edge implement at the tip was carried out in the same direction The generating means of a fog-like lubricating oil is established. While the lubricating oil of the shape of a fog made to generate with this generating means blows off from the tip of each cutting-edge implement through the cutting fluid supply pipe formed in each spindle shaft center-of-rotation section at the nonrotation condition The multiaxial spindle head of the machine tool characterized by considering as the configuration supplied to each lubrication necessary part which exists in the electric shielding space of a head frame.

[Claim 2] In the multiaxial spindle head by which two or more arrangement of the spindle shaft equipped with the cutting-edge implement at the tip is carried out in the same direction The duct for supplying the lubricating oil of the shape of a fog made to generate with this generating means while forming the generating means of a fog-like lubricating oil in the exterior of a head frame into the electric shielding space of a head frame is formed. While the lubricating oil of the shape of a fog supplied in electric shielding space blows off from the tip of each cutting-edge implement through the cutting fluid supply pipe formed in each spindle shaft center-of-rotation section at the nonrotation condition The multiaxial spindle head of the machine tool characterized by supplying each lubrication necessary part which exists in electric shielding space, such as a gearing and bearing.

[Claim 3] The multiaxial spindle head of the machine tool according to claim 2 or 3 characterized by forming the path for circulating the lubricating oil of the shape of a fog in electric shielding space in the suitable part of a head frame.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed explanation of a design]

[0001] [The technical field to which a design belongs]

This design is related with the multiaxial spindle head of the machine tool with which a fog-like lubricating oil blows off from a cutting-edge implement point.

[0002] [Description of the Prior Art]

Although cutting oil is supplied to the processing section so much in processing by the machine tool for removal of cooling and the lubrication of a workpiece or a cutting-edge implement, or swarf etc. The big cost accompanying the bad influence to the health of the environmental pollution by cutting oil, or the body, and the waste oil treatment of cutting oil when based on this, Since there are problems, such as a fall of the cutting-edge implement life by the supercooling of a workpiece or slipping wear at the time of detailed infeed processing of the cutting-edge implement by the excess of cutting oil, and also a lot of cutting oil at the time of processing adheres to swarf, it is necessary in the case of processing of swarf or reuse to separate the cutting oil adhering to this.

[0003] In order to solve these problems, in recent years, making the cutting oil of ultralow volume into the shape of a fog, and supplying the cutting section is performed, and such processing is called dry cutting etc.

[0004] By the way, in the multiaxial spindle head of a machine tool, in case the comparatively deep part of a workpiece is cut, what was made as [make / fog-like cutting oil / blow off from the tip of each cutting-edge implement] exists so that the lubrication of the cutting-edge implement point can be carried out effectively. As for cutting oil, it is [lubrication necessary parts established in the way among head casing in this kind of multiaxial spindle head, such as bearing and a gearing,] common that lubrication is carried out with the fluid lubrication oil of another kind.

[0005] [Problem(s) to be Solved by the Device] In the above-mentioned conventional multiaxial spindle head, it is necessary to establish two kinds of lubrication means of the lubrication of the cutting-edge implement point by cutting oil, and the lubrication of the bearing to a lubricating oil, and a gearing, and the structure for lubrication and a maintenance are complicated, and in order that a liquefied lubricating oil may generate many frictional heat and may result a process tolerance fall during rotation of a spindle shaft, improvement in the speed of spindle shaft rotation is restricted.

This design aims at offering the multiaxial spindle head of the machine tool which shall cope with this actual condition.

[0006] [Means for Solving the Problem] In the multiaxial spindle head by which two or more arrangement of the spindle shaft equipped with the cutting-edge implement at the tip is carried out in the same direction about this design in order to attain the above-mentioned purpose The generating means of a fog-like lubricating oil is established, and while the lubricating oil of the shape of a fog made to generate with this generating means blows off from the tip of each cutting-edge implement through the cutting fluid supply pipe formed in each spindle shaft center-of-rotation section at the nonrotation condition, it makes with the configuration supplied to each lubrication necessary part which exists in the electric shielding space of a head frame.

[0007] According to this, the lubrication of each lubrication necessary part in said electric shielding space besides the point of the cutting-edge implement with which the fog-like lubricating oil is cutting the deep part of a workpiece is carried out, and a fog-like lubricating oil carries out the lubrication of many lubrication necessary parts efficiently while making generating of the frictional heat accompanying rotation of a spindle mitigate.

[0008] The above-mentioned invention is materialized still as follows.

Namely, the duct for supplying the lubricating oil of the shape of a fog made to generate with this generating means while forming the generating means of a fog-like lubricating oil in the exterior of a head frame into the electric shielding space of a head frame is formed. While the lubricating oil of the shape of a fog supplied in electric shielding space blows off from the tip of each cutting-edge implement through the cutting fluid supply

pipe formed in each spindle shaft center-of-rotation section at the nonrotation condition, it makes with the configuration supplied to each lubrication necessary part which exists in electric shielding space, such as a gearing and bearing. According to this, the generating means and duct of a lubricating oil exist in the exterior of a head frame, and it is easy to perform handling and maintenance.

[0009] Furthermore, the path for circulating the fog-like lubricating oil in electric shielding space is formed in the suitable part of a head frame. Thereby, a flow by circulation of a fog-like lubricating oil or the outflow to the head frame exterior is promoted, and each lubrication necessary part which exists in electric shielding space, such as a gearing and bearing, carries out lubrication certainly.

[0010] [The gestalt of implementation of a design] The side view sectional view showing the important section of the machine tool possessing the multiaxial spindle head which drawing 1 requires for the example of this design, drawing 1 in which drawing 2 shows the x-x section of drawing 1, and drawing 3 are the expanded sectional views of said spindle head.

[0011] In these drawings, 1 is a bed and the movable carriage equipped with 2 possible [actuation of cross directions f1 and f2] through guidance orbital 1a of the top face of this bed 1 and 3 are the multiaxial spindle heads fixed to the top face of a movable carriage 2.

[0012] The multiaxial spindle head 3 is specifically made as follows.

That is, while having the main head frame 4 fixed to the movable carriage 2, the spindle section 5 is formed in the front face of this frame 4. It comes to carry out bolt immobilization of the spindle section 5 in the front face of the main head frame 4 in middle head frame 5a and anterior part head frame 5b.

[0013] Middle head frame 5a has the standing-up wall 6 and the side-attachment-wall section 7, and anterior part head frame 5b consists of a standing-up wall 8 and the spindle case section 9.

Under the present circumstances, the standing-up wall 8 carries out bolt immobilization at the main head frame 4 or middle head frame 5a, and bore 8a in which the spindle shaft 10 is inserted as shown in a specific location at drawing 3 is formed every spindle shaft 10.

S1 and S2 are electric shielding space before and after surrounding with these head frames 4, 5a, and 5b, and these are mutually opened for free passage through bore 8a.

[0014] The spindle case section 9 consists of the outer wall section 11 of the shape of a rectangle for surrounding two or more spindle shafts 10, and a middle wall 12 located between the spindle shafts 10.

[0015] As the circular bore a corresponding to each spindle shaft 10 shows drawing 3, it is formed in the front section of the outer wall section 11, and bolt immobilization of the front end side covering 13 to which the spindle shaft 10 is inserted in the front face of each bore a is carried out.

[0016] Each spindle shaft 10 consists of diameter voluminousness of anterior part 10a, and posterior part thin diameter section 10b, and is supported free [rotation in the fixed location on anterior part head frame 5b] by the bearing 14 attached in Bore a, and the bearing 15 attached in bore 8a. the shaft-orientations part of the core of each spindle shaft 10 -- a direct-like hole -- b -- forming -- **** -- this hole -- the anterior part b1 of b is made with the shape of a path size.

16 is being fixed to the spindle shaft 10 by the covering member for wearing the front face of the front end side covering 13.

[0017] The tool holder 18 with which the cutting-edge implement 17 was fixed makes the anterior part b1 of the above-mentioned hole b have carried out attachment immobilization. Under the present circumstances, the cutting oil bores c1 and c2 are formed in each shaft-orientations part of cutting-edge implement 17 cores and tool holder 18 core.

[0018] the hole of the spindle shaft 10 -- the method of the inside of b -- this hole -- the cutting oil supply pipe 19 of the shape of direct [thinner than the path of b] is formed in the spindle shaft 10 and this alignment. the hole with which the back end was prepared in this supply pipe 19 by the standing-up wall 6 of posterior part case frame 5a -- while being located in 6b and carrying out bolt immobilization through the bond part material 20a and 20b at the standing-up wall 6, the front end is located in the cutting oil bore c2 of the tool holder 18. Under the present circumstances, bearing 21 is formed between the anterior part of the cutting oil supply pipe 19, and Hole b, and it is made for the cutting oil supply pipe 19 not to check smooth rotation of the SUPINNDORU shaft 10.

[0019] Each spindle shaft 10 is made as [drive / with the main shaft drive motor 22 with which the main head frame 4 was decorated], and is specifically made as follows.

That is, the driving shaft 23 combined with the output shaft of the main shaft drive motor 22 is formed in the anterior part of the spindle section 5 and middle head frame 5a, and 5b place free [rotation in a fixed location], and a motor gear 24 is formed in the point section of this driving shaft 23. On the other hand, a collar gear 25 is fixed to the back end section of each spindle shaft 10, and interlocking connection of this collar gear 25 and motor gear 24 is carried out by the gear train which consists of two or more intermediate gears 26. Under the

present circumstances, d is the bearing supported for the center-of-rotation shaft of a motor gear 24 and an intermediate gear 26, enabling free rotation.

[0020] Thus, ahead [of the constituted multiaxial spindle head 3], a bed 1, a fixed relative configuration, and the made workpiece standing ways 27 are formed. Under the present circumstances, the envelopment frame part material 28 is fixed to the perimeter of back-face 27a of the workpiece standing ways 27.

[0021] 29 -- the front face of the multiaxial spindle head 3 -- the upper part of the circumference of the pivoting point 30 -- evacuation -- it is covering equipment with which it was equipped movable and possible [telescopic motion of cross directions f1 and f2], and has surrounded in the condition that only the lower part side was wide opened by the envelopment frame part material 28 in the anterior part of Workpiece w and the multiaxial spindle head 3 in contact with the shape of dense, at the time of processing.

[0022] 31 is arranged so that the inferior surface of tongue of covering equipment 29 may be worn on the hopper form guidance way for guiding swarf, and 32 is slideway equipment for showing the swarf which fell from the hopper form guidance way 31 to a suitable part.

[0023] 33 is the generator of the fog-like lubricating oil for generating a fog-like lubricating oil, and is equipped with the compressed-air supply pipe 34, filter 35a, pressure adjuster 35b, atomization equipment 35c, and the lubricating oil delivery valve 36. The lubricating oil delivery valve 36 makes the bore p1 of the wall surface of the main head frame 4, and the bore p2 of the skin 12 of anterior part head frame 5b open for free passage through a duct 37, and the solenoid valve 38 by which closing motion actuation is carried out is formed in timely in the middle of duct 37.

[0024] Furthermore, while forming a clearance suitable between the front end side covering 13 and spindle shaft 10 peripheral face, the bore p3 for forming the clearance suitable also between the front end of the front end side covering 13 and the rear face of the covering member 16 which existed ahead of this, and making the standing-up wall 6 of middle cylinder-head-cover 5a open the space before and behind this for free passage is formed.

[0025] Next, the example of use of the constituted this example article and its actuation are explained like the above.

In case Workpiece w is fixed, a movable carriage 2 is moved to back f2 from the location of drawing 1. Thereby, the first transition of covering equipment 29 separates from the envelopment frame part material 28, and the cross-direction overall length of covering equipment 29 will be in the longest condition with the energization means which is not illustrated. Covering equipment 29 is evacuated from the condition of drawing 1 to the upper part of the circumference of the pivoting point 30, workspace is secured widely, and Workpiece w is made to fix to back-face 27a of the workpiece standing ways 27 under this condition.

[0026] Then, covering equipment 29 is returned to a original location, and the main shaft drive motor 22 is operated.

Thereby, rotation of this motor 22 is transmitted to each spindle shaft 10 through gears 24, 25, and 26, and each spindle 10 is guided at bearing 14 and 15, and is rotated.

[0027] Since it is fixed to the standing-up wall 6, each cutting oil supply pipe 19 is held also during rotation of the spindle shaft 10 at a nonrotation condition. Moreover, bearing 21 prevents certainly contact on the cutting oil supply pipe 19 and the spindle shaft 10.

[0028] On the other hand, open actuation of the solenoid valve 38 is carried out if needed. The compressed air supplied from the compressed-air supply pipe 34 flows into generator 35c of a fog-like lubricating oil by this, and atomization equipment 35c generates a fog-like lubricating oil by the atomizer principle.

[0029] The lubricating oil of the shape of this fog is supplied through a duct 35 and bores p1 and p2 in the electric shielding space s1 of the head frames 4, 5a, and 5b, and s2, and it flows into each cutting oil supply pipe 19, and among this, that part turns a way to the front f1, and flows it. The condition of having been distributed equally is held without the lubricating oil of the shape of a fog which is flowing the inside of this cutting oil supply pipe 19 not receiving an operation of the centrifugal force by that rotation at all, even if the spindle shaft 10 rotates, therefore not producing the liquefaction phenomenon by the centrifugal force [in the cutting oil supply pipe 19], and producing the segregation phenomenon by the specific gravity difference between that constituent, since the cutting oil supply pipe 19 does not rotate.

[0030] This fog-like lubricating oil blows off from the front end of the cutting oil supply pipe 19 soon, and blows off in the state of comparatively equal distribution from the tip of the cutting-edge implement 17 through the cutting oil bores c1 and c2 of the tool holder 18 or the cutting-edge implement 17.

[0031] moreover -- that the electric shielding space s1 and the thing which did not flow in the cutting oil supply pipe 19 among the lubricating oils supplied in s2 circulate through the inside of the electric shielding space s1 and s2 through the bore p3 grade as a path according to the flow induction operation by rotation of gears 24 and 25 and 26 grades **** -- the clearance between bearing 14 and 15 -- and It flows into the method of

outside through the clearance between each spindle shaft 10 and its front end side covering 13.

Circulation of these lubricating oils and a flow accompanying the method outflow of the outside make a detailed lubricating oil grain adhere that there are no spots in each lubrication necessary part of gearings 24, 25, and 26, bearing 14, and 15 grades, and, thereby, the lubrication of each lubrication necessary part is carried out without an intermission with these lubricating oil grain.

[0032] next, the elasticity of the energization means which is not illustrated while the movable carriage 2 was moved to the front f1 under such an operating state, the front end edge of covering equipment 29 carried out the pressure welding to the back end edge of the envelopment frame part material 28 by this migration and covering equipment 29 had had this pressure-welding condition held henceforth -- resisting -- advance of a movable carriage 2 -- compaction deformation is carried out, responding to a variation rate.

[0033] And if front migration of a movable carriage 2 reaches fixed magnitude, the cutting-edge implement 17 will reach Workpiece w, and will process this. Also during this processing, a fog-like lubricating oil blows off from the tip of the cutting-edge implement 17, and even if the cutting-edge implement 17 will be in the condition of processing the deep part of Workpiece w, the lubrication of the necessary part will be carried out effectively. In addition, in case the workpiece w which processing ended is removed from the workpiece standing ways 27, it is based on the reverse procedure when equipping with this.

[0034] [Effect of the Device] According to this design constituted like the above, a fog-like lubricating oil to a cutting-edge implement point In addition, in order to carry out the lubrication also of each lubrication necessary part in the electric shielding space of a head frame, It becomes that by which lubrication is simply carried out while the comparatively deep part of a workpiece can be cut. Moreover, since a fog-like lubricating oil makes generating of the frictional heat accompanying rotation of a spindle shaft mitigate, while being able to maintain process tolerance good, speeding up of cutting by improvement in the speed of spindle rotation can be attained. Furthermore, by lubricating oil flow by the air current, a lubrication means can be made as it is simple, and also the maintenance becomes simple.

[0035] According to claim 2, handling and maintenance of a fog-like lubricating oil of a generating means, a duct, etc. can be performed simple.

[0036] According to claim 3, since circulation of the lubricating oil of the shape of a fog in electric shielding space etc. is promoted, each lubrication necessary part which exists in electric shielding space, such as a gearing and bearing, carries out lubrication certainly.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the side view sectional view showing the important section of the machine tool possessing the multiaxial spindle head concerning the example of this design.

[Drawing 2] It is drawing showing the x-x section of drawing 1 .

[Drawing 3] It is the expanded sectional view of said spindle head.

[Description of Notations]

4, 5a, 5b Head frame

10 Spindle Shaft

14 15d Bearing (lubrication necessary part)

17 Cutting-Edge Implement

19 Cutting Fluid Supply Pipe

24, 25, 26 Gearing (lubrication necessary part)

33 Generating Means of Fog-like Lubricating Oil

p3 Path

s1, s2 Electric shielding space

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WRITTEN AMENDMENT

[Procedure revision]

[Filing Date] March 19, Heisei 11

[Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] Claim 2

[Method of Amendment] Modification

[Proposed Amendment]

[Claim 2] The multiaxial spindle head of the machine tool according to claim 1 characterized by forming the generating means of a fog-like lubricating oil in the exterior of a head frame.

[Procedure amendment 2]

[Document to be Amended] Specification

[Item(s) to be Amended] Claim 3

[Method of Amendment] Modification

[Proposed Amendment]

[Claim 3] The multiaxial spindle head of the machine tool according to claim 1 or 2 characterized by forming the path for circulating the lubricating oil of the shape of a fog in electric shielding space in the suitable part of a head frame.

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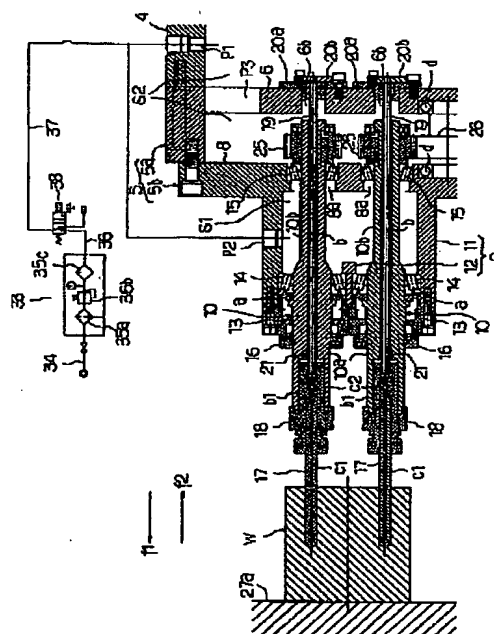
(74)代理人 弁理士 伴熊 弘裕

(54)【考案の名称】 工作機械の多軸スピンドルヘッド

(57)【要約】

【課題】 被加工物wの深い個所を切削できるものであっても、所要個所の潤滑が簡易に行えるものとする。

【解決手段】 先端に刃具17を備えたスピンドル軸10が同一方向へ複数配設される多軸スピンドルヘッドに於いて、霧状潤滑油の発生手段33を設け、この発生手段33で生成した霧状潤滑油が各スピンドル軸10回転中心部に非回転状態に設けられた切削液供給管19を経て各刃具17の先端から噴出されると共にヘッドフレーム4、5a、5bの遮蔽空間S1、s2内に存在する各潤滑所要個所14、15、b及び26に供給される構成となす。



1

2

【実用新案登録請求の範囲】

【請求項1】 先端に刀具を備えたスピンドル軸が同一方向へ複数配設された多軸スピンドルヘッドに於いて、霧状潤滑油の発生手段を設け、この発生手段で生成させた霧状の潤滑油が各スピンドル軸回転中心部に非回転状態に設けられた切削液供給管を経て各刀具の先端から噴出されると共にヘッドフレームの遮蔽空間内に存在する各潤滑所要個所に供給される構成としたことを特徴とする工作機械の多軸スピンドルヘッド。

【請求項2】 先端に刀具を備えたスピンドル軸が同一方向へ複数配設される多軸スピンドルヘッドに於いて、ヘッドフレームの外部に霧状潤滑油の発生手段を設けると共にこの発生手段で生成させた霧状の潤滑油をヘッドフレームの遮蔽空間内へ供給するための管路を形成し、遮蔽空間内に供給された霧状の潤滑油が各スピンドル軸回転中心部に非回転状態に設けられた切削液供給管を経て各刀具の先端から噴出されると共に遮蔽空間内に存在する歯車や軸受等の各潤滑所要個所に供給されることを特徴とする工作機械の多軸スピンドルヘッド。

* 【請求項3】 ヘッドフレームの適当個所に遮蔽空間内の霧状の潤滑油を流通させるための通路を形成したことを特徴とする請求項2又は3記載の工作機械の多軸スピンドルヘッド。

【図面の簡単な説明】

【図1】 本考案の実施例に係る多軸スピンドルヘッドを具備した工作機械の要部を示す側面視断面図である。

【図2】 図1のx-x部を示す図である。

【図3】 前記スピンドルヘッドの拡大断面図である。

【符号の説明】

4、5 a、5 b ヘッドフレーム

10 スピンドル軸

14、15、d 軸受（潤滑所要個所）

17 刀具

19 切削液供給管

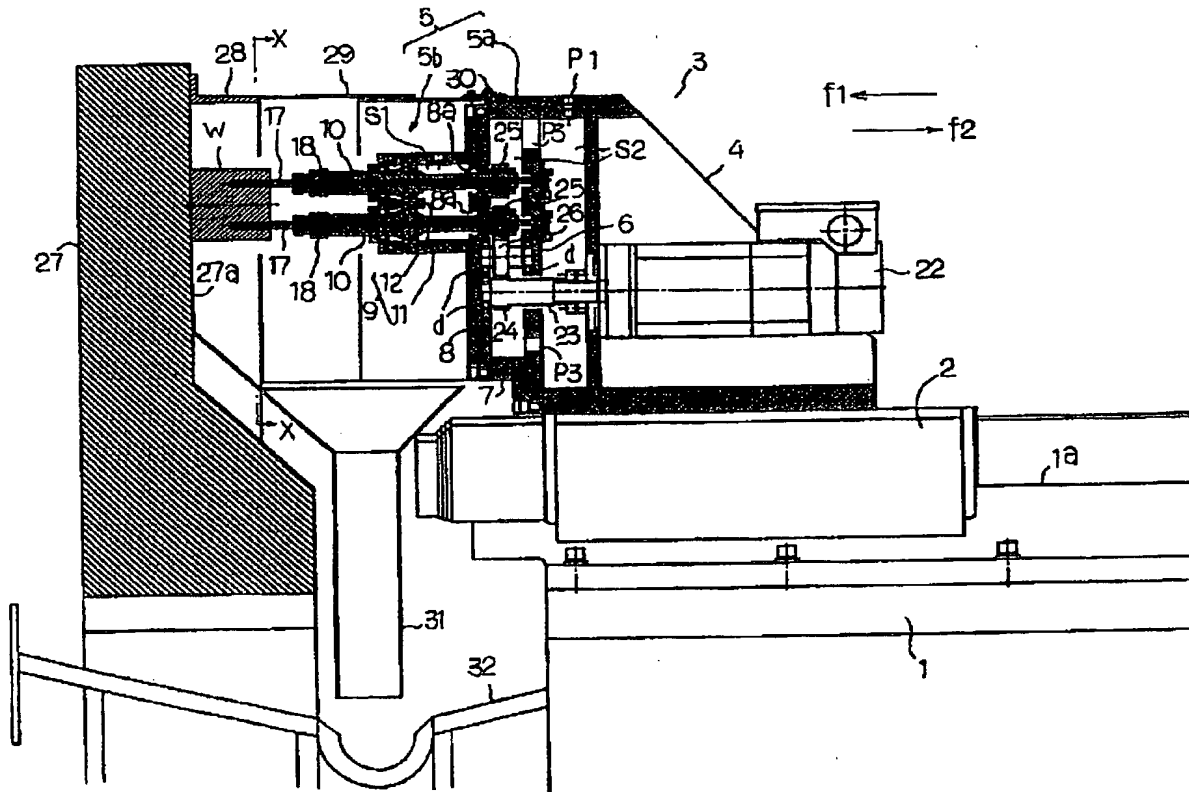
24、25、26 歯車（潤滑所要個所）

33 霧状潤滑油の発生手段

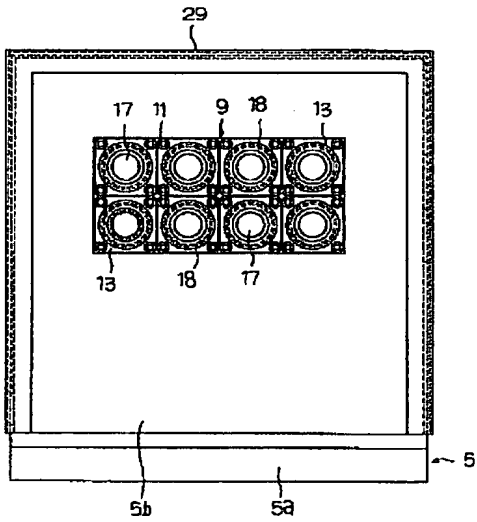
p 3 通路

s 1、s 2 遮蔽空間

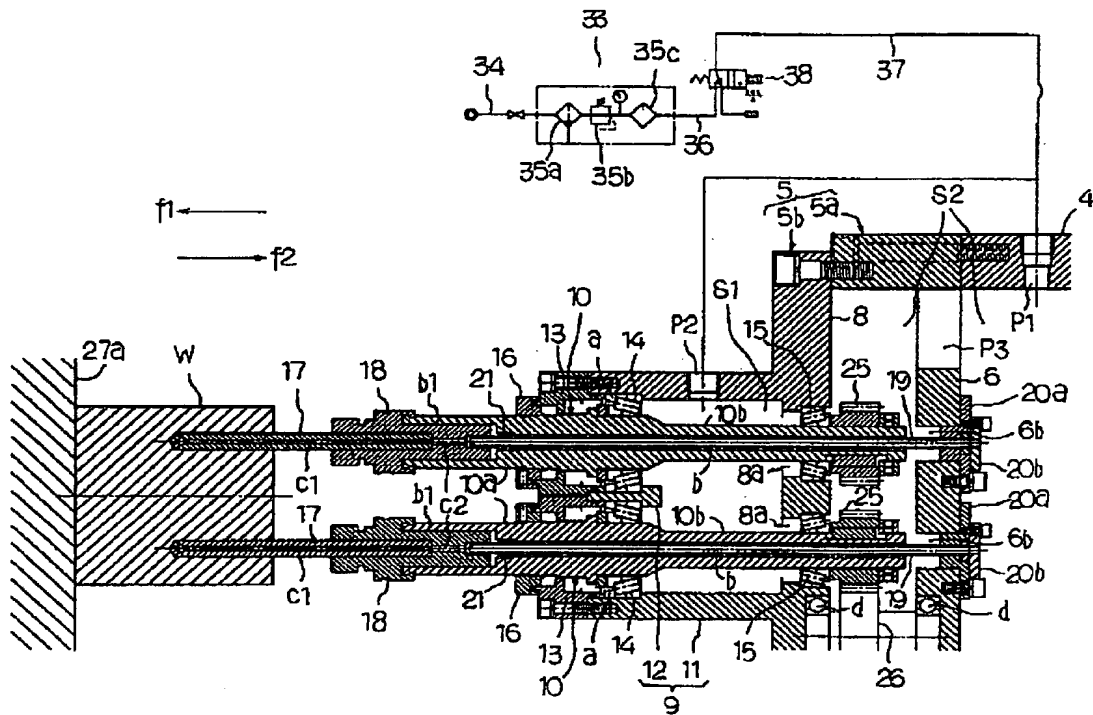
【図1】



【図2】



【図3】



【手続補正書】

【提出日】平成11年3月19日

【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】請求項2

【補正方法】変更

【補正内容】

【請求項2】 ヘッドフレームの外部に霧状潤滑油の発生手段を設けたことを特徴とする請求項1記載の工作機械の多軸スピンドルヘッド。

【手続補正2】

【補正対象書類名】明細書

【補正対象項目名】請求項3

【補正方法】変更

【補正内容】

【請求項3】 ヘッドフレームの適当個所に遮蔽空間内の霧状の潤滑油を流通させるための通路を形成したことを特徴とする請求項1又は2記載の工作機械の多軸スピンドルヘッド。

【考案の詳細な説明】**【0001】****【考案の属する技術分野】**

本考案は、刃具先端部から霧状潤滑油が噴出される工作機械の多軸スピンドルヘッドに関する。

【0002】**【従来技術】**

工作機械による加工では被加工物や刃具の冷却及び潤滑、又は切屑の除去などのため加工部に切削油を多量に供給しているが、これによるときは切削油による環境汚染や人体の健康への悪影響、切削油の廃油処理に伴う大きなコスト、被加工物の過冷却による刃具寿命の低下、又は切削油過多による刃具の微細切込み加工時の滑り磨耗などの問題があるほか、加工時に多量の切削油が切屑に付着するため、切屑の処理や再利用のさい、これに付着した切削油を分離することが必要となる。

【0003】

これらの問題を解決するため、近年では極微量の切削油を霧状にして切削加工部へ供給することが行われているのであり、このような処理はドライ切削などと称されている。

【0004】

ところで、工作機械の多軸スピンドルヘッドに於いては、被加工物の比較的深い個所を切削する際に刃具先端部を効果的に潤滑することができるよう、各刃具の先端から霧状の切削油を噴出させるようなしたものが存在している。

この種の多軸スピンドルヘッドでは、ヘッドケーシングの内方に設けられた軸受や歯車等の潤滑所要個所は切削油とは別種の液状潤滑油により潤滑されるのが一般的である。

【0005】**【考案が解決しようとする課題】**

上記した従来が多軸スピンドルヘッドでは、切削油による刃具先端部の潤滑と、潤滑油による軸受及び歯車の潤滑との二種類の潤滑手段を設ける必要があつて

潤滑のための構造やメンテナンスが複雑化し、また液状の潤滑油がスピンドル軸の回転中に多くの摩擦熱を発生して加工精度低下の原因をなすため、スピンドル軸回転の高速化が制限されるのである。

本考案は、斯かる実情に対処し得るものとした工作機械の多軸スピンドルヘッドを提供することを目的とする。

【0006】

【課題を解決するための手段】

上記目的を達成するため、本考案では、先端に刃具を備えたスピンドル軸が同一方向へ複数配設される多軸スピンドルヘッドに於いて、霧状潤滑油の発生手段を設け、この発生手段で生成させた霧状の潤滑油が各スピンドル軸回転中心部に非回転状態に設けられた切削液供給管を経て各刃具の先端から噴出されると共にヘッドフレームの遮蔽空間内に存在する各潤滑所要個所に供給される構成となす。

【0007】

これによれば、霧状の潤滑油が、被加工物の深い個所を切削している刃具の先端部のほか、前記遮蔽空間内の各潤滑所要個所を潤滑するのであり、また霧状の潤滑油はスピンドルの回転に伴う摩擦熱の発生を軽減させると共に多数の潤滑所要個所を効率的に潤滑するものとなる。

【0008】

上記発明はさらに次のように具体化する。

即ち、ヘッドフレームの外部に霧状潤滑油の発生手段を設けると共にこの発生手段で生成させた霧状の潤滑油をヘッドフレームの遮蔽空間内へ供給するための管路を形成し、遮蔽空間内に供給された霧状の潤滑油が各スピンドル軸回転中心部に非回転状態に設けられた切削液供給管を経て各刃具の先端から噴出されると共に遮蔽空間内に存在する歯車や軸受等の各潤滑所要個所に供給される構成となす。これによれば、潤滑油の発生手段や管路がヘッドフレームの外部に存在して取扱いや保守の行い易いものとなる。

【0009】

さらに、ヘッドフレームの適当個所に遮蔽空間内の霧状潤滑油を流通させるた

めの通路を形成する。これにより、霧状の潤滑油の循環流動やヘッドフレーム外部への流出による流動が促進され、遮蔽空間内に存在する歯車や軸受等の各潤滑所要個所が確実に潤滑されるものとなる。

【0010】

【考案の実施の形態】

図1は本考案の実施例に係る多軸スピンドルヘッドを具備した工作機械の要部を示す側面視断面図、図2は図1のx-x部を示す図、図3は前記スピンドルヘッドの拡大断面図である。

【0011】

これらの図に於いて、1はベッドで、2はこのベッド1の上面の案内軌道1aを介して前後方向f1、f2の作動可能に装着された移動台、そして3は移動台2の上面に固定された多軸スピンドルヘッドである。

【0012】

多軸スピンドルヘッド3は具体的には次のようになされている。

即ち、移動台2に固定された主ヘッドフレーム4を備えると共に、このフレーム4の前面にスピンドル部5を形成されている。スピンドル部5は中間ヘッドフレーム5aと前部ヘッドフレーム5bとを主ヘッドフレーム4の前面にボルト固定されてなる。

【0013】

中間ヘッドフレーム5aは起立壁部6と側壁部7を有しており、また前部ヘッドフレーム5bは起立壁部8とスピンドルケース部9とからなる。

この際、起立壁部8は主ヘッドフレーム4や中間ヘッドフレーム5aにボルト固定し、特定位置に図3に示すようにスピンドル軸10の挿通される透孔8aが各スピンドル軸10毎に形成されている。

S1及びS2はこれらヘッドフレーム4、5a、5bで囲まれた前後の遮蔽空間であり、これらは透孔8aを介して互いに連通されている。

【0014】

スピンドルケース部9は複数のスピンドル軸10を包囲するための方形状の外壁部11と、スピンドル軸10間に位置した中間壁部12とからなる。

【0015】

外壁部11の前面部には各スピンドル軸10に対応した円形の透孔aが図3に示すように形成されており、各透孔aの前面にはスピンドル軸10の挿通される前端面カバー13がボルト固定されている。

【0016】

各スピンドル軸10は前部径大部10aと後部細径部10bとからなっていて、透孔aに嵌着された軸受14と透孔8aに嵌着された軸受15とで前部ヘッドフレーム5b上の一定位置での回転自在に支持されている。各スピンドル軸10の中心部の軸方向個所には直状の孔bが形成してあり、この孔bの前部b1は径大状となされている。

16は前端面カバー13の前面を被うためのカバー部材でスピンドル軸10に固定されている。

【0017】

上記孔bの前部b1には刃具17の固定された工具ホルダ18が嵌着固定させてある。この際、刃具17中心部及び工具ホルダ18中心部の各軸方向個所には切削油透孔c1、c2が形成される。

【0018】

スピンドル軸10の孔bの内方にはこの孔bの径より細い直状の切削油供給管19がスピンドル軸10と同心に設けてある。この供給管19は後端を後部ケースフレーム5aの起立壁部6に設けられた孔6b内に位置され、結合部材20a、20bを介して起立壁部6にボルト固定されると共に、前端を工具ホルダ18の切削油透孔c2内に位置されている。

この際、切削油供給管19の前部と孔bとの間には軸受21を設け、切削油供給管19がスピンドル軸10の円滑な回転を阻害しないようにする。

【0019】

各スピンドル軸10は主ヘッドフレーム4に装設された主軸駆動モータ22で駆動されるようになされており、具体的には次のようになされている。

即ち、主軸駆動モータ22の出力軸に結合された原動軸23をスピンドル部5の前部及び中間ヘッドフレーム5a、5b個所に一定位置での回転自在に設け、

この原動軸23の先部に原動歯車24を形成する。一方では各スピンドル軸10の後端部に従動歯車25を固定し、この従動歯車25と原動歯車24とを複数の中間歯車26からなる歯車列で連動連結させる。この際、dは原動歯車24及び中間歯車26の回転中心軸を回転自在に支持した軸受である。

【0020】

このように構成した多軸スピンドルヘッド3の前方にはベッド1と一定相対配置となした被加工物固定台27が設けてある。この際、被加工物固定台27の支持面27aの周囲には包囲枠部材28が固定される。

【0021】

29は多軸スピンドルヘッド3の前面に枢着点30廻りの上方へ退避移動可能且つ前後方向f1、f2の伸縮可能に装着されたカバー装置で、加工時は包囲枠部材28に密状に接して被加工物wや多軸スピンドルヘッド3の前部を下方側のみ開放された状態に包囲するものとなしてある。

【0022】

31は切屑を案内するためのホッパー形案内路でカバー装置29の下面を被うように配設しており、また32はホッパー形案内路31から落下した切屑などを適当箇所へ案内するための案内面装置である。

【0023】

33は霧状の潤滑油を生成するための霧状潤滑油の発生装置で、圧縮空気供給管34、フィルター35a、圧力調整装置35b、霧化装置35c及び潤滑油送出管36とを備えている。潤滑油送出管36は管路37を介して主ヘッドフレーム4の壁面の透孔p1と前部ヘッドフレーム5bの外壁面12の透孔p2とに連通させてあり、管路37途中には適時に開閉作動される電磁弁38が設けてある。

【0024】

さらに、前端面カバー13とスピンドル軸10外周面との間に適当な隙間を形成すると共に、前端面カバー13の前端とこれの前方に存在したカバー部材16の後面との間にも適当な隙間を形成しており、また中間ヘッドカバー5aの起立壁6にはこれの前後の空間を連通させるための透孔p3が形成してある。

【0025】

次に上記の如く構成した本実施例品の使用例及びその作動を説明する。

被加工物wを固定する際は、移動台2を図1の位置から後方f2へ移動させる。これによりカバー装置29の前縁は包囲枠部材28から離れ、カバー装置29の前後方向全長は図示しない付勢手段により最長状態となる。この状態の下で、カバー装置29を図1の状態から枢着点30廻りの上方へ退避させて作業空間を広く確保し、被加工物固定台27の支持面27aに被加工物wを固定させる。

【0026】

この後、カバー装置29を原位置に戻し、主軸駆動モータ22を作動させる。これにより、このモータ22の回転は歯車24、25、26を介して各スピンドル軸10に伝達され、各スピンドル10は軸受14、15に案内されて回転する。

【0027】

各切削油供給管19は起立壁部6に固定されているため、スピンドル軸10の回転中に於いても非回転状態に保持される。また、軸受21は切削油供給管19とスピンドル軸10との接触を確実に阻止するものとなる。

【0028】

この一方では必要に応じて電磁弁38を開放作動させる。これにより、圧縮空気供給管34から供給される圧縮空気が霧状潤滑油の発生装置35c内へ流入し、霧化装置35cは霧吹き原理で霧状の潤滑油を生成する。

【0029】

この霧状の潤滑油は管路35及び透孔p1、p2を経てヘッドフレーム4、5a、5bの遮蔽空間s1、s2内に供給され、その一部は各切削油供給管19内へ流入し、これの内方を前方f1へ向け流動するものとなる。この切削油供給管19内を流動している霧状の潤滑油は、切削油供給管19が回転しないため、スピンドル軸10が回転してもその回転による遠心力の作用を全く受けないのであり、従って切削油供給管19内に於いて遠心力による液化現象を生じず且つその構成成分間の比重差による成分分離現象を生じることもなく、均等に分布された状態を保持される。

【0030】

この霧状潤滑油はやがて切削油供給管19の前端から噴出され、工具ホルダ18や刃具17の切削油透孔c1、c2を通じて刃具17の先端から比較的均等な分布状態で噴出されるのである。

【0031】

また遮蔽空間s1、s2内に供給された潤滑油のうち切削油供給管19内に流入しなかったものは歯車24、25、26等の回転による流動誘発作用により遮蔽空間s1、s2内を通路としての透孔p3等を通じて循環流動したり、軸受14、15の隙間及び、各スピンドル軸10とその前端面カバー13との隙間を経て外方へ流出する。

これら潤滑油の循環流動や、その外方流出に伴う流動は、微細な潤滑油粒を歯車24、25、26や軸受14、15等の各潤滑所要個所に斑なく付着させるのであり、これにより各潤滑所要個所はこれら潤滑油粒により間断なく潤滑される。

【0032】

次にこのような作動状態の下で移動台2を前方f1へ移動させるのであり、この移動によりカバー装置29の前端縁が包囲枠部材28の後端縁と圧接し、以後、カバー装置29はこの圧接状態を保持されたまま図示しない付勢手段の弾力に抗して移動台2の前進変位に応じつつ短縮変形される。

【0033】

そして移動台2の前方移動が一定大きさに達すると、刃具17が被加工物wに達し、これを加工するものとなる。この加工中にも、霧状の潤滑油が刃具17の先端から噴出され、たとえ刃具17が被加工物wの深部を加工する状態となっても、所要個所を効果的に潤滑するものとなる。

なお、加工の終了した被加工物wを被加工物固定台27から取り外すさいはこれを装着したときの逆の手順による。

【0034】**【考案の効果】**

以上の如く構成した本考案によれば、霧状の潤滑油が刃具先端部に加えて、へ

ッドフレームの遮蔽空間内の各潤滑所要個所をも潤滑するようになるため、被加工物の比較的深い個所を切削できるものでありながら簡易に潤滑されるものとなり、また霧状の潤滑油がスピンドル軸の回転に伴う摩擦熱の発生を軽減させるため加工精度を良好に維持し得ると共にスピンドル回転の高速化による切削の迅速化が図れるのであり、さらに気流による潤滑油流動により潤滑手段を簡易となすことができるほか、そのメンテナンスも簡便となるものである。

【0035】

請求項2によれば、霧状潤滑油の発生手段及び管路等の取扱いや保守が簡便に行えるものとなる。

【0036】

請求項3によれば、遮蔽空間内に於ける霧状の潤滑油の循環流動等が促進されるため、遮蔽空間内に存在する歯車や軸受等の各潤滑所要個所が確実に潤滑されるものとなる。